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DEPARTMENT OF NATURAL RESOURCES
AND ENVIRONMENTAL CONTROL
DIVISION OF AIR AND WASTE MANAGEMENT
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March 31, 1993

Mr. Paul Johnston
Standard Chlorine of Delaware, Inc.
Governor Lea Road
P.O. Box 319
Delaware City, Delaware 19706

SUBJECT: Comments on the Draft Feasibility Study
Standard Chlorine of Delaware, Inc. Superfund Site
Delaware City, New Castle County, Delaware

Dear Mr. Johnston:

Attached are comments from the Delaware Department of Natural Resources and Environmental Control (DNREC) and the U.S. EPA on the draft Feasibility Study document submitted to the agencies by Standard Chlorine of Delaware, Inc. (SCD). General comments are attached first and specific comments are attached second.

DNREC would like to propose a meeting to discuss any questions about these comments between representatives of the regulatory agencies, SCD and its consultant, Weston, after you have had the opportunity to review this letter. April 15, 1993, is suggested as a possible date. Please contact me at 323-4540 to discuss such a meeting.

The revised version of the Feasibility Study should be submitted to the Department by April 30, 1993.

Sincerely,

Anne V. Hiller

Anne V. Hiller
Environmental Scientist III
Superfund Branch

Attachments

AVH:avh/dw
AVH93025.wp

pc: Kate Lose (3HW42)
N.V. Raman
Karl Kalbacher

ATTACHMENT 1
General Comments on the Draft Feasibility Study (FS)
Standard Chlorine of Delaware, Inc. Superfund Site

Remedial Alternatives

1. Each of the alternatives (with the exception of No Action) must address compliance with ARARS and adequate protectiveness of human health and the environment. In particular, Alternative 2 should be upgraded to comply with this requirement. Please see specific comments in Attachment 2.

2. The elevated levels of contaminants in the subsurface soils at the site act as a continuing source of contamination for ground water. Various insitu treatment technologies have been used at numerous other sites as the remedial alternative for subsurface soils. For example, a case study using hot air steam stripping proved to be effective in removing chlorinated benzenes. Based on the information contained in the FS the regulatory agencies do not understand why the technologies that would directly address subsurface soils at the site were eliminated from consideration. Therefore, further explanation as to the reasons for eliminating technologies must be included and if this information does not satisfy the regulatory agencies, at least one of the alternatives discussed in Section 4 and 5 of the Feasibility Study must include one or more of the following technologies:

   - soil vapor extraction
   - soil flushing
   - insitu air/bio sparging
   - insitu steam extraction
   - hot air steam stripping

   This issue should be discussed in more detail at our proposed meeting in April.

3. On pages ES-3 and 1-23 of the report, a very brief discussion of subsurface soil contamination is presented. It is implied in the FS that because a complete and direct exposure pathway to contaminated subsurface soil does not currently exist at the site, this environmental medium is not considered for remediation. However, while direct contact with subsurface soil may not be a prevailing concern at the site for humans, the following point should be acknowledged:

   In the absence of a secure and impermeable cap, subsurface soil will act as a continual source of contamination to underlying ground water. The contaminated groundwater then discharges to the surface water causing potential surface water quality problems as well as ecological impacts in the Red Lion Creek, unnamed tributary, and the wetlands associated with each.

   According to page ES-8 of the FS, only those soils containing the "highest" concentrations of contaminants will be removed and treated; any remaining surface soils exceeding response levels will be contained by caps. Please note, however, that typically in the Superfund Program, *all* soils containing contaminants in excess of health-based, eco-based or ground water protection-based levels, as appropriate, are remediated.

   Institutional controls such as deed restrictions, fencing, health and safety measures for future excavation activities can be one component of the approach to the remediation of the contaminated soils.

4. To assist in the comparative analysis of the alternatives presented in the FS, a table that provides a summary of the various response actions for each of the alternatives should be provided. The

mediums under evaluation should include surface soil, sediment, subsurface soil, ground water, and surface water and evaluate human as well as ecological risks. This table should be similar to the attached example from "Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA, OSWER Directive 9355.3-01, October 1988".

5. Several (if not all) of the alternatives will cause various degrees of ecological and habitat impacts which have not been addressed in the alternatives discussions. Each of the alternatives should address ramifications to the ecological systems and include ecological restoration efforts. Ecological restoration may be able to be done in such a way as to reduce Operations and Maintenance (O&M) costs.

6. Each of the alternatives should evaluate remedial action for the Catch Basin #1, subsurface soils and DNAPLs. Subsurface soils should be treated as a separate medium in each of the alternatives.

7. Each of the alternatives should delineate the amount of waste to be treated, response levels, and time frames for remediation (intermediate as well as final). A table format is suggested.

8. Each of the alternatives must provide more detail on the monitoring systems associated with the remedial efforts.

Groundwater Loadings to Red Lion Creek

1. The draft FS states that the flux of contaminated groundwater discharging to the unnamed tributary and Red Lion Creek does not result in a significant impact to the surface water quality. This assessment is not substantiated in the Feasibility Study. As we have discussed in the past, modelling of the contaminant loading to the unnamed tributary and the Red Lion Creek should be completed and included in the final report. In our proposed meeting on April 15, 1993, a discussion of the approach taken in this modelling effort should occur. Please provide a written proposal for review prior to the meeting.

2. Contamination of ground water should not be dismissed on the basis of protection of human health through the supply of alternative potable health to human receptors. Ground water contamination (i.e., the Columbia aquifer) still carries a serious potential for ecological impacts through groundwater contamination of surface water and wetlands.

Soil and Groundwater Cleanup Levels

Since RI data shows that subsurface soils are contaminated in areas up to 32 feet below ground surface (see page 1-16 of FS), evaluation and consideration of subsurface soils should be performed when evaluating the soil remedial alternatives. Soil clean-up levels for subsurface soils should be estimated to be protective of ground water quality (i.e. eliminate subsurface soil sources). Modelling (such as MULTIMED or Summers Method) must be conducted to develop clean-up levels for the subsurface soils that are protective of ground water as part of the Feasibility Study. EPA's hydrogeologist will work with Standard Chlorine during the process to insure that the modelling satisfies EPA's criteria. In our proposed April 15, 1993, meeting, a discussion of the approach taken in this modelling effort should occur. Please provide a written proposal for review before the meeting.

Archaeology Issues

SCD received a copy of the March 12, 1993, memo from Faye L. Stocum of the Historic Preservation Office regarding the draft Feasibility Study and the Phase IA Archaeology Survey conducted for the site. DNREC requests that revisions of the Phase 1A report in accordance with the comments in the memo be completed, parallel with revisions of the draft FS, and at the same time arrangements for conducting the Phase IB site work begin. A workplan for the Phase IB work must be submitted to the Department and EPA for review by April 30, 1993. As we discussed on March 26, 1993, conference calls between representatives of SCD, your archaeological contractor, DNREC and the Office of Historic Preservation to discuss issues may be a way to expedite this activity.

The costs of compliance with the National Historic Preservation Act should be integrated into the cost tables for the remedial alternatives.

Bioremediation Treatability Study

The results of the ongoing treatability study should be included in the final FS document if possible, or if not possible as the already agreed upon addendum. Since finalization of the FS is running approximately two weeks behind schedule, it may be possible to incorporate the results of the treatability study directly into the document instead of creating a separate addendum to address the results.

Textual Comments

Please review the document for typographical errors and incorrect or awkward phrasing. A number of instances were found where small words were apparently missing from the text.

ATTACHMENT 2
Specific Comments on the Draft Feasibility Study
Standard Chlorine of Delaware, Inc. Superfund Site

EXECUTIVE SUMMARY

1. Pg. ES-2, paragraph 1. The opening statement should be modified to reflect the intent of the National Contingency Plan regarding remedial alternative selection: The national goal of the remedy selection process is to select remedies that are protective of human health and the environment, that maintain protection over time, and that minimize untreated waste (NCP Section 300.430(a)(i)).

3. Pg. ES-3, paragraphs 3 and 4. These paragraphs should be modified to reflect that the soil contamination present at the site is a possible source of groundwater contamination and then surface water contamination, especially the deeper soils at the site in the vicinity of the catch basin no. 1.

4. Pg. ES-3, paragraph 5. Please indicate that the silt fence was installed after the 1986 spill occurred and did not limit the migration of contamination into the Red Lion Creek during the spill.

5. Pg. ES-4, paragraph 4. This paragraph should be amended to include subsurface contamination along the effluent pipeline. In addition a statement concerning the impact of subsurface soils on ground water contamination should be provided.

6. Pg. ES-4, paragraph 4. The statement on page ES-4 concerning "minimal impact of ...to surface water quality..." must be eliminated through out the report. It should be replaced by a discussion of the results of the loading modelling discussed in the General Comments section.

7. Pg. ES-4, paragraph 3. Please note in the paragraph that air exposure from volatilization of soil contamination has been reduced but not eliminated by the installation of the soil pile covers.

8. Pg. ES-4, paragraph 4. Please note in this paragraph that the groundwater samples from the Potomac Formation aquifer were collected from wells located outside the site boundaries.

9. Pg. ES-5. Alternative 2 - Containment as discussed on page ES-5 is misleading since the alternative does not contain the contamination.

10. Pg. ES-6. Please revise the statement regarding the effectiveness of Alternative 3 in protecting the environment in light of comments in Attachment 2, Section 5, Alternative 3.

11. Pg. ES-8. "Highest concentration" and "natural attenuation" should be defined.

12. Pg. ES-8. Please discuss the time frame needed for the natural attenuation process to degrade the contaminants.

SECTION 1

1. Site operational history should include a description of the current and potential markets for the products produced at Standard Chlorine of Delaware. Section 1 should also include an analysis of the contaminants at the site to address the chemical reactions and breakdown products during degradation under anaerobic and aerobic conditions.

2. Neither in the Remedial Investigation (RI) nor the FS is there information which indicates that actual Dense Non Aqueous Phase Liquid (DNAPL) was measured in any on-site monitoring or extraction well, and yet in the quarterly monitoring reports, several wells are reported with DNAPL. Information should be included in the FS as to which wells have historically contained DNAPL, thickness, and chemical and physical characteristics, if known. The location, thickness, and chemical analysis should be included in a Table and the narrative should discuss their occurrence in Sections 1.4 or 1.5 of the FS. The narrative should in turn cite the Table.

3. Pg. 1-5, paragraphs 3 and 4. This paragraph should be accompanied with a figure showing the relationship of the Merchantville Formation to the Potomac Formation in the area of the site for clarification.

4. Pg. 1-7, paragraph 3. Please describe the depth to the water table using current monitoring information.

5. Pg. 1-10, paragraph 2. This paragraph should be expanded to identify the results of the annual inspections of the new CB1. Are the underground lines discharging to CB1 tested and inspected?

6. Pg. 1-14. Section 1.5 should include a discussion of the findings of the Effluent Pipeline Investigation.

7. Pg. 1-15, paragraph 2. Please state to what depth below the seven foot sampling interval samples were obtained.

8. Pg. 1-17, paragraph 1. Please include the range of contamination values found in the wetland area of the unnamed tributary and south of the diked area.

9. Pg. 1-17, paragraph. 2. In summarizing the nature and extent of the contamination found at the Red Lion Creek sediments, it is more relevant to the purpose of this narrative to describe the distribution of the contamination (e.g., the furthest downstream extent and detected concentration) in Red Lion Creek. Description of the location of highest contamination of sediment in Red Lion Creek should be discussed as well.

10. Pg. 1-17, para 3. Please rewrite the first sentence to explain that interstitial water was sampled in the sedimentation basin monitoring zone, not surface water. the wording of this sentence has caused some confusion during review.

11. Pg. 1-18, paragraph 2. Please state that the explanation of DNAPL migration direction is based on current knowledge of the structural surface of the top of the confining unit.

12. Pg. 1-19, paragraph 3. Please describe briefly the locations of the wells in the site vicinity used to monitor the Potomac Formation aquifer.

13. Please include site maps defining the areas delineated by the response levels in this section.

14. Pg. 1-19 and 1-20. Non-carcinogenic and carcinogenic risks, as determined by the Baseline Risk Assessment (BLRA) are discussed in this section. While it is recognized that future potential use of ground water as a potable source at the site is not probable, the risks associated with this pathway (as calculated in the BLRA) should be provided (quantitatively) in the FS.

15. Pg. 1-23, paragraph. 2. No discussion is provided in this report as to the important part that these contaminated subsurface soils would play as a continual source to ground water contamination.

16. Pg. 1-23, paragraph 6. The integrity of the cover over the soil piles and its ability to reduce the migration of contaminants due to volatilization and the durability of the cover should be discussed. Please state also that the soil pile covers were approved by DNREC as a temporary measure, not a final measure.

17. Pg. 1-23, paragraph 1. Please address subsurface contamination in the vicinity of the effluent underground pipeline. This section should also note that although there may not be direct receptors, the subsurface contamination is a source of ground water contamination.

SECTION 2

1. Pg. 2-2. The remedial action objective of preventing exposure to groundwater/surface water containing organic compounds in excess of the risk-based or ARAR-based action levels should be included in this section.

2. Pg. 2-5, Table 2-1. The list of ARARs should include the Coastal Zone Management Act for Location. Please also review the list of ARARs to make sure that necessary ecological ARARs have been included.

3. Pg. 2-5, Table 2-1. Please review the Table and correct the names of the appropriate Delaware regulations. Additional regulations that should be included are: Delaware Regulations Governing the Use of Subaqueous Lands,amended 9/92; Delaware Wetlands Act of 1973, revised 6/84; Delaware Regulations Governing Sediment and Stormwater Control; State of Delaware Regulations Governing the Construction of Water Wells; Delaware Coastal Zone Act, amended 9/92; Delaware Executive Order 56 on Freshwater Wetlands; State of Delaware Regulations for Licensing Water Well Contractors, Pump Installers, Contractors, Well Drillers, and Well Drivers; Delaware Regulations Governing the Allocation of Water; Delaware Regulations Governing Control of Water Pollution; Delaware Sediment and Stormwater Regulations; Delaware Regulations Governing Hazardous Substance Cleanup; Delaware Environmental Protection Act; 7 Del. Code, Chap. 63.

4. ARARs should not be distinguished as to applicability or appropriateness and relevance.

5. Pg. 2-7, paragraph 4. Please revise the third sentence to reflect the uncertainty or apparent nature of the conclusion regarding the limitation of the groundwater contamination to the shallow Columbia Formation aquifer.

6. Pg. 2-9, Table 2-2. As of December, 1992, 1 μg/l is the *final* (rather than the *proposed*) Maximum Contaminant Level (MCL) for hexachlorobenzene. Table 2-5 should also be modified to reflect this point.

7. Pg. 2-9, Table 2-2. The MCL for 1,2,4-trichlorobenzene is 70 μg/l.

8. Pg. 2-10, Table 2-3. Please review the table in light of the newly revised Delaware Surface Water Quality Standards (February, 1993).

9. Pg. 2-29. According to page 2-29, for carcinogens, response levels equivalent to a cancer risk of 1.0E-05 were established for the site. Please note, however, that EPA's point-of-departure for carcinogenic risk is 1.0E-06, with the potentially acceptable range being from 1.0E-06 to 1.0E-04, depending upon site-specific conditions. In any case, it is EPA's site manager who determines acceptable risk, not the PRP.

10. On page 2-30 of the report, it appears as though a *total* clean-up level of 625 mg/kg was calculated for soil contaminants at the site. However, this approach for establishing remediation goals is inappropriate, since it assumes that all contaminants are of equal toxicity or carcinogenic potential. Clean-up levels must be derived for each contaminant of concern at the site.

SECTION 3

1. A more detailed rationale for elimination of technologies should be included in the text discussions. In some instances the reasons given for elimination were not convincing. For example, sufficient rationale for eliminating solvent rinsing/soil washing was not provided on page 3-39 and 3-40.

2. Soil washing, soil flushing, insitu steam/hot air injection with vapor extraction appear to be viable alternatives for soil remediation and must be evaluated more thoroughly (page 3-58, 59).

4. Air sparging and bio sparging for remediation of contaminated groundwater appear to be viable technologies and should be evaluated in the FS.

5. Pg. 3-15, paragraph 1. The practical depth limitation of a slurry wall is stated to be 25 feet. This is incorrect. Slurry walls can be extended up to 150 feet, depending on site conditions.

   The greatest recorded depth to the Merchantville/Potomac Clay at the site is over 70 feet. Slurry walls can be constructed to this depth and at even greater depths. Consequently, depth is not a limiting factor as far as engineering feasibility.

   Pg. 3-51, Table 3-3. Please revise this table for depth of slurry walls as discussed in the above comment.

6. Pg 3-15 and Table 3-3. For Interceptor Trenches discussed in this Table and on page 3-15: A more detailed description of the depth limitation of 25 feet should be provided in the narrative. The importance of identifying whether the limitation in depth for this technology is associated with current engineering technology and equipment or cost. A specific detailed discussion must be provided as to engineering difficulties that would make it difficult if not impossible to implement.

7. Pg. 3-38, paragraph 1. Please define KPEG.

8. Pg. 3-62, Table 3-5. Please include in the FS a figure(s) to accompany this table. Rationale for depth of area must be provided. Subsurface contaminated soils must be included in the volume calculations. It is recommended that a similar table be generated for each of the alternatives discussed in Section 4, to include volume of treatment for ground water, surface soils, subsurface soils, sediments. Area of capping should also be provided where appropriate.

SECTION 4

1. In the development and screening of Remedial Alternatives, each of the alternatives (with the exception of No Action) must satisfy minimum criteria as described below:

   a) must provide adequate protection of human health and the environment; and

   b) must meet the requirements of all federal and state ARARS.

In addition, each of the alternatives must provide information on the amount of waste/media to be treated, duration of clean-up, time frames for treatment, achievable intermediate and final clean-up levels.

2. Each alternative must provide a discussion and address remediation of subsurface soils, CB1, and DNAPL(s).

3. Inconsistency of approach in discussing implementability, effectiveness, and cost of the various alternatives makes it very difficult to compare them. Please review these section and make them consistent in approach.

4. Please describe the difference between "readily accessible, highly contaminated soils" and "sediments and soils exceeding response levels" in the beginning of the section. Some of the discussions are confusing without a clear distinction.

5. Please define the depth used in describing surface soils and reasons for it early in this section. The discussions are unclear until Table 4-5 is reached and even then it is unclear why the depth of 3 feet is used.

6. Pg. 4-3, Table 4-1. Why were the innovative treatment technologies: thermal treatment (XTRAX) and biological treatment (reductive dechlorination) not factored into the soil alternatives? Please include a discussion in the text.

7. Pg. 4-5, Table 4-2. Why were the innovative treatment technologies: thermal treatment (XTRAX) and biological treatment (reductive dechlorination) not factored into the sediment alternatives? Please include a discussion in the text.

8. Pg. 4-6, Table 4-3. Why were biological treatment (aerobic/anaerobic) and chemical/physical treatment (adsorption using synthetics) not factored into the groundwater alternatives? Please provide a discussion in the text.

9. Pg. 4-17,paragraph 4. Please provide a reference for the thermal description treatability study.

SECTION 5

Overall Comments

1. All alternatives must discuss remediation of subsurface soils, DNAPLs, and CB1. Based on historical data, the Catch Basin appears to be a continuing source of contamination and each of the alternatives must address a means of remediating/containing the contamination.

2. For evaluation purposes Section 5 should include calculations of cubic yards, gallons, etc. of soil to be treated, capped, contained. Use of a table for each of the alternatives is recommended.

3. The costs of compliance with the National Historic Preservation Act should be integrated into the cost tables for the remedial alternatives.

4. Terms such as "readily accessible" and "highly contaminated" must be clearly defined whenever they are used.

5. Pg. 5-2, paragraph 1. Please define ROD.

Alternative 1

Pg. 5-7 The rate of the passive biodegradation mechanism should be incorporated in the text.

Alternative 2

1. Alternative 2 must comply with ARARs and it does not currently appear to do so. Please modify this alternative so that it does comply with ARARs.

2. Page 5-7 is incorrect when it states that Alternative 2 will provide on-site containment. This alternative does not adequately provide for on-site containment. This alternative would more appropriately be labeled "Limited Action" in that it only provides for limited action above and beyond the existing pump and treat and monitoring system.

3. Pg. 5-13, paragraph 4. The statement is made that "...final capping and closure will address the RCRA design criteria for surface impoundment closure". This is incorrect (see 40 CFR Ch.1 Section 264.228).

Alternative 3

1. Alternative 3 does not adequately address remediation of the sediments in the unnamed tributary. Figure 5-6 identifies areas along the sides of the unnamed tributary to be excavated. Analytieal results from the RI reveal that most sampling locations downgradient of the soil dike are contaminated. This alternative must provide an option for excavation and treatment of sediments above response levels.

2. On page 5-20, a slurry wall should be included as an alternative for containing groundwater. Please discuss briefly possible contingency measures for treatment of off-gases in the event that production processes are curtailed and the discharge can no longer be burned in the boilers. In addition, please reference documentation that the boilers can effectively destroy/remove the volatile and semi-volatile constituents.

3. Pg. 5-23. Please discuss briefly alternative technologies (other that air stripping) that could be used for treating wastewater, which in turn will treat contaminated ground water. Please let DNREC know if SCD believes that the recent events regarding the NPDES effluent discharge permit will have any effects on the Feasibility Study.

4. Pg. 5-23. Details on volume of soil to be excavated and stabilized should be provided. Table 3-5 suggests excavation to a depth of 3 feet, whereas sample location #SS-29 showed contamination to a depth of five feet.

5. Pgs. 5-22, 5-24, Figures 5-4 and 5-5. Concern has arisen that care should be taken in choosing the location of the interceptor trench in that it should be located out of the flood plain and at a higher elevation than the expected ground water seasonal high. Please clarify the figures and text.

6. Please discuss in more detail the effectiveness of the interceptor trench in controlling the seeps.

7. Please include a more detailed discussion about the liner proposed for the interceptor trench and the ramifications of either including the liner in the alternative or not.

8. The new silt fence discussed on page 5-32 will only minimize migration and should only be considered as an interim measure as opposed to a permanent solution.

9. Rationale for the extent of the asphalt cap around the catch basin should be included in the description.

10. Justification and rationale for placement of manholes 300 feet apart for the interceptor trench should be included in the description.

Alternative 4

1. Pg. 5-39. The technology for treatment of contaminated ground water must be delineated.

2. Provide more detail on the LTTT, size of unit, flow input, management of contaminated media, etc.

3. Please expand the description of free product recovery.

4. Pg. 5-40, Figure 5-7. Concern exists that the recovery well locations proposed in Figure 5-7 may not encounter free organics because the distribution of the free organics on this site did not coincide with the contouring of the confining unit (see Fig. 3-6, RI report). Therefore it appears that recovery well locations should be placed near and down-slope of monitoring wells TW-5, TW-28, TW-30 (ones that have shown free organics since 1988). Please indicate uncertainty as to number and location of Product Recovery wells.

5. Pg. 5-40, Figure 5-7. Please depict the existing wells which have historically contained DNAPL directly on this figure.

Alternative 5

The results of the Bioremediation Treatability Study must be submitted with the revised FS to demonstrate its application and limitation.

Details on ultimate disposition of soil piles after bioremediation should be included.

SECTION 6

Pg. 6-2. It is mentioned that the on-site groundwater is expected to meet MCLs over the long term. An approximate time frame should be furnished for each alternative.

United States
Environmental Protection
Agency

Office of Emergency and
Remedial Response
Washington DC 20460

OSWER Directive 9355.3-01
October 1988

Superfund

EPA

Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA

Interim Final

General Response Action			1 No Action	2 Limited Action	3 Source Containment; No GW Controls	4 Source Containment; GW Collection, Pretreatment, POTW	5 In Situ Stabilization, Cap; GW Collection, Pretreatment, POTW	6 Biodegradation, Cap; GW Collection, Pretreatment, POTW	7 Incineration; GW Collection, Pretreatment, POTW
Medium	Technology Type	Area or Volume							
Soil	Access Restrictions (Fencing)	Entire Site		●					
	Excavation	All Soil Above 10^{-6}							●
		All Soil Above 10^{-4}			●	●			
	Disposal	Onsite RCRA Landfill			●				
		Offsite RCRA Landfill				●			●
	Treatment Onsite	In Situ Stabilization					●		
		Bioremediation To 10^{-4}						●	
	Incineration Offsite								●
	Capping	All (Remaining) Soil Above 10^{-6}			●	●	●	●	
Ground Water[a]	Alternate Water Supply	All Residents In Affected Area		●	●	●	●		
	Monitoring	All Monitoring Wells Twice A Year	●	●	●	●	●	●	●
	Collection With Interceptor Trenches	All Water Above 10^{-4} Within 10 Yrs.				●	●		
		All Water Above 10^{-6} Within 20 yrs						●	●
	Treatment With Precipitation Onsite	Pretreatment				●	●	●	●
	Discharge	Offsite To POTW				●	●	●	●

[a] This is a conceptual example using the example of carcinogenic risk ranges; however, in general, when MCLs are available they will apply.

Figure 4-8. Assembling a range of alternative examples.

4.3 Alternatives Screening Process

4.3.1 Alternatives Definition

Before beginning screening, alternatives have been assembled primarily on medium-specific considerations and implementability concerns. Typically, few details of the individual process options have been identified, and the sizing requirements of technologies or remediation timeframes have not been fully characterized (except for timeframes identified to develop ground-water action alternatives). Furthermore, interactions among media, which may influence remediation activities, have usually not been fully determined, nor have sitewide protectiveness requirements been addressed. Therefore, at this point in the process, such aspects of the alternatives may need to be further defined to later phases of the FS when alternatives are refined and evaluated on a sitewide basis.

If modeling of transport processes is undertaken during the alternative development and screening phases of the FS to evaluate removal or collection technologies, and if many contaminants are present at the site, it may be necessary to identify indicator chemicals, as is often done for the baseline risk assessments, to simplify the analysis. Typically, indicator chemicals are selected on the basis of their usefulness in evaluating potential effects on human health and the environment. Commonly selected indicator chemicals include those that are highly mobile and highly toxic.

4.2.5.2 Implementability Evaluation

Implementability encompasses both the technical and administrative feasibility of implementing a technology process. As discussed in Section 4.2.4, technical implementability is used as an initial screen of technology types and process options to eliminate those that are clearly ineffective or unworkable at a site. Therefore, this subsequent, more detailed evaluation of process options places greater emphasis on the institutional aspects of implementability, such as the ability to obtain necessary permits for offsite actions, the availability of treatment, storage, and disposal services (including capacity), and the availability of necessary equipment and skilled workers to implement the technology.

4.2.5.3 Cost Evaluation

Cost plays a limited role in the screening of process options. Relative capital and O&M costs are used rather than detailed estimates. At this stage in the process, the cost analysis is made on the basis of engineering judgment, and each process is evaluated as to whether costs are high, low, or medium relative to other process options in the same technology type. As discussed in Section 4.3, the greatest cost consequences in site remediation are usually associated with the degree to which different general technology types (i.e., containment, treatment, excavation, etc.) are used. Using different process options within a technology type usually has a less significant effect on cost than does the use of different technology types.

4.2.6 Assemble Alternatives

In assembling alternatives, general response actions and the process options chosen to represent the various technology types for each medium or operable unit are combined to form alternatives for the site as a whole. As discussed in Section 4.1.2.1, appropriate treatment and containment options should be developed. To assemble alternatives, *genera response actions should be* combined using differen technology types and different volumes of medi and/or areas of the site. Often more than one genera response action is applied to each medium. Fo example, alternatives for remediating soi contamination will depend on the type and distributio of contaminants and may include incineration of soil from some portions of the site and capping of others.

For sites at which interactions among media are not significant (i.e., source control actions will not affect ground-water or surface-water responses) the combination of medium-specific actions into site wide alternatives can be made later in the FS process, either after alternatives have been screened or prior to conducting the comparative analysis of alternatives. For example, if media interactions are not of concern, an FS might describe three source control options, three soil remediation options, and four ground-water remediation options, (instead of developing numerous comprehensive sitewide alternatives). Although this approach permits greater flexibility in developing alternatives and simplifies the analyses of sitewide alternatives, it may involve greater effort in developing and analyzing medium-specific options.

Figure 4-6 illustrates how general response actions may be combined to form a range of sitewide alternatives. For this relatively simple example, the two media of interest are soil and ground water. The range of alternatives developed include a no-action alternative (alternative 1); a limited action alternative (alternative 2); source containment options with and without ground water treatment (alternatives 3 and 4); and three alternatives that employ various levels of source treatment, with ground-water collection and treatment (alternatives 5, 6, and 7).

Although not shown in this example, a description of each alternative should be included in the FS report. For the alternatives presented in Figure 4-6, such descriptions would include the locations of areas to be excavated or contained, the approximate volumes of soil and/or ground water to be excavated and collected, the approximate locations of interceptor trenches, the locations of potential city water supply hook-ups, the locations of connections to the local publicly owned treatment works (POTW), management options for treatment residuals, and any other information needed to adequately describe the alternative and document the logic behind the assembly of general response actions into specific remedial action alternatives. In describing alternatives, it may be useful to note those process options that were not screened out and that are represented by those described in the alternative.